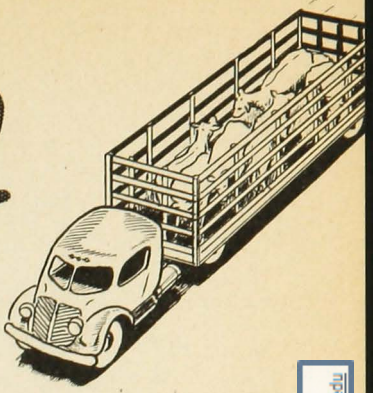
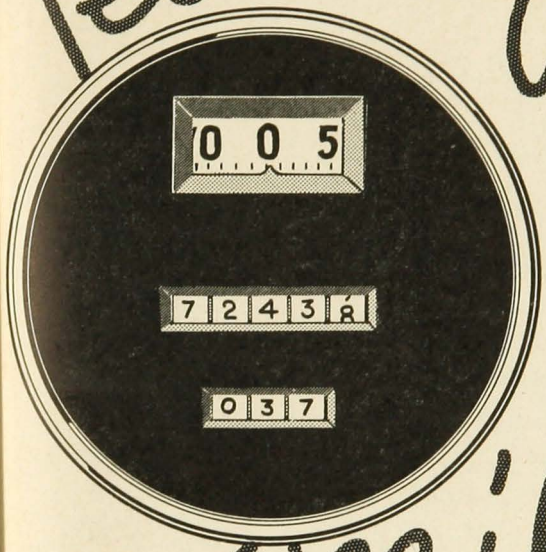
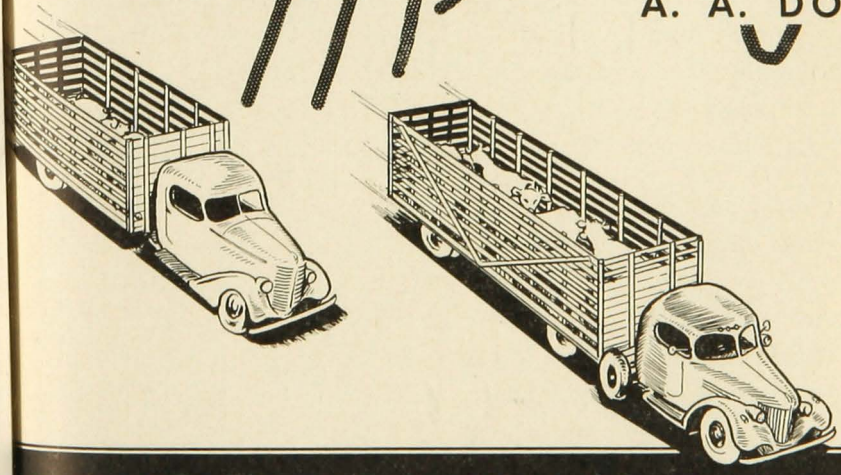
Reducing LIVESTOCK TRUCK Mileage





A. A. DOWELL



AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF MINNESOTA

CONTENTS

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Reducing Livestock Truck Mileage[1]

A. A. Dowell

MOST of the livestock marketed by Minnesota farmers is moved from the farms by motor trucks. In some areas, trucks are used chiefly for local assembly and the animals are forwarded to markets or packing plants by rail. However, the greater part of the movement to markets and packing plants within the state is made entirely by truck. Consequently, the efficiency with which trucks are used to transport livestock, both locally and to various market outlets, is of interest to the majority of Minnesota farmers. Commercial truckers also are concerned with this problem. They are interested in eliminating unprofitable local trips and in obtaining full loads to distant markets and return loads whenever possible. Efficient transportation contributes to national welfare by conserving essential resources and manpower and by reducing marketing costs. Such savings are essential under the existing situation, but they are also important under more normal conditions.

WITH the expansion of livestock trucking, it became increasingly apparent that trucks were not being operated at maximum efficiency at all times. However, the exact nature and extent of these inefficiencies were not known, and without such basic information it was not possible to formulate effective plans for reducing livestock truck mileage. This study was undertaken to supply some of the needed information. The principal objectives were: (1) to ascertain the number, age, size, and condition of commercial trucks available for transporting livestock in a typical southwestern Minnesota county; (2) to determine the operating efficiency of these trucks, both when engaged in hauling livestock locally and when engaged in the over-the-road movement to distant markets; and (3) to suggest ways and means for improving the operating efficiency of trucks used to transport livestock at both local and distant market levels.

[1] The data for this study were obtained in Martin County by Arthur R. Karr, agricultural conservation agent, Agricultural Extension Service, and Gerald Engelman, research assistant, Division of Agricultural Economics. The author also is indebted to County Agent Stanley B. Simpson; to Fred Niss, chairman of the Martin County Agricultural Conservation Committee; to the operators of commercial livestock and general trucks; to the local press; and to the representatives of various civic organizations in Martin County, for their cooperation in connection with this and other phases of the Martin County transportation study. The commercial livestock and general truck schedule used in connection with this study was adapted from a schedule developed by the Corn Belt Livestock Marketing Research Committee.

Assistance in the preparation of this material was furnished by the personnel of Work Projects Administration, Official Project No. 265-1-71-236, Subproject No. 508.

Source and Character of the Data

THIS study was limited to the commercial livestock and general trucks located in, or operating in, Martin County, Minnesota. These trucks were owned and operated chiefly by commercial livestock truckers; by local livestock dealers who hauled for themselves, or for hire, or both; and by others who operated trucks for hire, mainly in hauling farm products and supplies. Included is a small number of trucks operated by business firms primarily to deliver supplies and materials sold by them to farmers and others in the community. Trucks owned and operated privately by farmers: private trucks used by business firms chiefly for town delivery; or trucks engaged chiefly or entirely in hauling cream, eggs and poultry, or petroleum products, are not included. The only commercial trucks not located in Martin County which were included were those which made one or more trips to haul livestock, grain, feed, or other farm supplies into, or out of, Martin County during the week of the study.

Martin County was selected because it was believed that truck transportation arrangements in this county were fairly typical of most of south central and southwestern Minnesota. It is an important agricultural county producing considerable pork, beef, and dairy and poultry products. Since separate studies of operations of cream trucks, egg and poultry trucks, petroleum trucks, and farm trucks and automobiles were to be made concurrently with this study of commercial livestock and general trucks, it was essential to select a county fairly representative of meat, dairy, and poultry production areas.

The study was made during the week of August 2-8, 1942. Each truck operator was visited during the week preceding the study by representatives of the Division of Agricultural Economics, the Agricultural Extension Service, or local civic organizations. The schedules were explained and a supply of schedules and county maps left with each operator. The schedules called for information as to the age, size, condition, and operation of each truck located in or operated in Martin County during the seven-day period. Operators were asked to route each trip made during the week on the Martin County maps. Data also were requested as to the number of pickup stops, number of animals, weight of animals, and return loads, together with similar information on all other hauling within, into, or out of the county during the week.

The field workers devoted the week of the study to interviewing and assisting the individual truckers with the schedules and maps. Several days also were spent in the county the following week to complete the gathering of data. It is believed that the information supplied for the Martin County trucks covers practically all of the livestock as well as other hauling done by them during this period. On the other hand, the data do not give a complete picture of livestock or other hauling by the out-of-county trucks, as operators of these trucks were not asked to supply information on hauling done exclusively outside of Martin County.

The study is concerned primarily with truck operating efficiency as measured by size of load hauled in relation to normal carrying capacity of the truck, length of trip, weight of livestock hauled per mile, and overlapping truck trips and territories. It does not include a study of truck operating costs and hence throws no light upon the relative economy of trucks of various types and sizes when used for various purposes.

Commercial Livestock and General Trucks

Number of Trucks

A TOTAL of 123 commercial livestock and general trucks were located in, or operated in, Martin County during the week of the study. Of these, 99 were located in Martin County, 20 in adjoining Minnesota counties, and 4 in Iowa. The Martin County trucks included 67 with Minnesota X, 2 with Minnesota T, 30 with Minnesota Y licenses.[2] The trucks from adjoining Minnesota counties included 15 with Minnesota X and 5 with Minnesota Y licenses.

Most Common Use

Operators reported that livestock, or livestock and grain, were the products most commonly hauled by over one half of the Minnesota X trucks, by 33 of the 35 Minnesota Y trucks, and by the 4 Iowa trucks. Grain or general farm products were reported as the chief freight hauled by an additional one third of the Minnesota X trucks. Most of the latter also were equipped to haul livestock. A relatively small proportion of the total was engaged chiefly in hauling products other than livestock and grain, such as feed, building materials, coal, etc.

Age of Trucks

The model year or age of the 123 commercial livestock and general trucks is shown by type of license in table 1. The trucks with Minnesota X licenses were considerably older on the average than those with Minnesota Y licenses. Nearly 24 percent of trucks

Table 1. Age of 123 Commercial Livestock and General Trucks Located in, or Operating in, Martin County, August 2-8, 1942

Model year	Type of license					
	Minnesota X			Minnesota Y		
	Number of trucks	Percent of total	Percent given year's model or older	Number of trucks	Percent of total	Percent given year's model or older
1942	3*	3.4	100.0	1	2.9	100.0
1941	10	11.4	96.6	11	31.4	97.1
1940	9	10.3	85.2	13	37.1	65.7
1939	10†	11.4	75.0	2	5.7	28.5
1938	11	12.5	63.6	6	17.1	22.8
1937	12	13.6	51.1	.....	.....	5.7
1936	12‡	13.6	37.5	1	2.9	5.7
1935	11*	12.5	23.9	.....	.....	2.9
1934	3	3.4	11.4	.....	.....	2.9
1933	3‡	3.4	8.0	.....	.....	2.9
1932	2	2.3	4.5	.....	.....	2.9
1931	1	1.1	2.3	1	2.9	2.9
1930	1	1.1	1.1	.....	.....	.....
Total	88	100.0		35	100.0	

* Includes one Iowa truck.
† Includes two Iowa trucks.
‡ Includes one truck with a Minnesota T license.

[2] Trucks with Minnesota X licenses are permitted to haul for hire only within a radius of 35 miles of the point of registration. Products produced and owned by the owner of the truck may be transported anywhere within the state. Trucks with Minnesota Y licenses are permitted unrestricted travel within the state. Minnesota T licenses are issued to farmers and farm cooperatives and limit the operations of the truck chiefly to the hauling of products and supplies to and from the owner's or member's farm.

Table 2. Average Miles Driven, and Miles Driven in 1941, by 123 Commercial Livestock and General Trucks Located in, or Operating in, Martin County, August 2-8, 1942

Type of license	Number of trucks	Average miles driven per truck	
		Total	In 1941
Minnesota X	84*	72,438	16,980
Minnesota Y	35	118,265	45,797
Iowa	4	115,440	29,000

* Includes two trucks with Minnesota T licenses.

with Minnesota X licenses were 1935 models or older, whereas only 3 percent of those with Minnesota Y licenses were as old as 1935. About 75 percent of the X trucks were 1939 models or older, compared with 29 percent of the Y trucks. In other words, 71 percent of the Minnesota Y trucks were 1940 models or later, while only 25 percent of the Minnesota X trucks were in this age group.

Miles Driven

The average total miles driven per truck up to the time of the study, and the average miles driven during 1941 are shown in table 2. The range in total miles traveled by Minnesota X trucks was from 12,000 to 347,000, with an average of 72,438 miles, and for the Minnesota Y trucks the range was from 25,000 to 550,000, with an average of 118,265 miles. The Y trucks traveled an average of 45,797 miles in 1941, compared with 16,980 miles for those with X licenses. The greater mileage of the former is natural as the trucks with X licenses are used chiefly for local hauling, while those with Y licenses are used chiefly in over-the-road transport to packing plants and markets located considerable distances from Martin County.

Capacity of Trucks

The average capacity of trucks with Minnesota Y licenses was considerably greater than of those with Minnesota X licenses (table 3). The gross-capacity[3] averaged nearly 23,000 pounds for the Y trucks and only slightly over 12,000 for the X trucks. The gross-capacity of the limited number of Iowa trucks was between these extremes, but more nearly comparable to the X than to the Y trucks.

Table 3. Capacity of 123 Commercial Livestock and General Trucks Located in, or Operating in, Martin County, August 2-8, 1942

Type of license	Number of trucks	Average O.D.T.* gross capacity	Average empty weight of trucks	Average net-capacity of trucks
		Pounds	Pounds	Pounds
Minnesota X	84†	12,295	5,837	6,458
Minnesota Y	35	22,949	10,459	12,489
Iowa	4	16,550	8,100	8,450

* Office of Defense Transportation.

† Includes two trucks with Minnesota T licenses.

[3] For definition of gross-capacity see page 7.

Measuring Truck Efficiency

SEVERAL factors may be considered in evaluating the efficiency with which trucks are used in hauling livestock. These include, among others, the percent gross-capacity, the percent net-capacity, and the weight of livestock hauled per mile.[4]

Gross-capacity refers to the weight of the empty truck plus the weight of the livestock hauled. The Office of Defense Transportation has developed a formula whereby the normal gross-capacity of a truck is determined by number and size of tires, and number of plies per tire.[5] When loaded at the normal carrying capacity of the tires, the truck is said to be loaded at 100 percent gross-capacity. The difference between 100 percent gross-capacity and the weight of the empty truck represents normal or 100 percent net-capacity. Thus, a truck loaded at 100 percent gross-capacity also is loaded at 100 percent net-capacity. In relatively few cases, however, are trucks loaded exactly at 100 percent capacity. Individual loads may vary slightly, or they may vary considerably, from this calculated normal.

Relationships between percent gross-capacity, percent net-capacity, and weight of livestock hauled per mile for a number of individual truck trips are shown in tables 4 and 5. The data in table 4 include six light loads of hogs and six typical heavy loads of hogs hauled by Martin County X trucks during the week of the study. Similar data for six light loads and six typical heavy loads of cattle hauled by Martin County X trucks are shown in table 5. In each case the individual loads are arrayed in order from lowest to highest on the basis of percent net-capacity.

It will be noted that trucks 7 and 8 in table 5 happened to have identical loads, as well as the same capacities, and traveled the same distance. Consequently, from any viewpoint, these trucks were operating at equal efficiency. However, it is seldom that identical trucks follow the same routes or render identical services when engaged in the local assembly or local hauling of livestock. Even when the same or similar trucks travel the same route to a distant market, the individual loads are seldom exactly alike. Commonly there are variations in trucks, loads, or distances. Thus, while trucks 7 and 8 in table 4 were the same size and carried the same weight of livestock, the weight hauled per mile varied because of variations in the distances hauled. Likewise, trucks 5 and 6 in table 5 were the same size and hauled identical loads, but the distance traveled by truck 6 was twice that made by truck 5, so that the weight of livestock hauled per mile was only half as much for truck 6 as for truck 5. In other words, the weight of livestock hauled per mile varies inversely with distance.

The importance of the weight of livestock hauled per mile as a measure of efficiency for trucks engaged in local hauling and loaded at less than capacity will be observed in both tables 4 and 5. For example, the trips made by trucks 1 and 2 in table 4 both appear to have been relatively

[4] Other efficiency measures which have been suggested include the percent maximum O.D.T. net-capacity, pounds of livestock hauled per square foot of truck space, and tire miles per 1,000 pounds of livestock hauled. It is to be expected that the methods and measures used in this bulletin will be refined or perhaps replaced in part or in full by others as additional research is brought to bear upon the problem.

[5] Chapter II. Office of Defense Transportation (general order O.D.T. No. 4) Part 501—Conservation of Motor Equipment, Contract Carriers of Property, April 20, 1942.

Table 4. Relationship between Percent Gross-capacity, Percent Net-capacity, and Weight of Livestock Hauled per Mile, on Selected Trips Made by Martin County X Trucks to Pick Up Hogs Only, Martin County, August 2-8, 1942

Truck No.	Number hogs picked up	Number of stops	Miles round trip	Weight picked up	Percent of O.D.T. capacity		Weight of livestock hauled per mile
					Gross	Net	
				Pounds			Pounds
Six light loads							
1	1	1	3	260	52.4	4.1	86.7
2	1	1	27	400	47.0	6.1	14.8
3	2	2	10	635	45.2	8.2	63.5
4	2	1	9	750	46.8	8.3	83.3
5	4	1	8	1,550	51.9	17.2	193.7
6	8	1	16	1,680	52.8	18.7	105.0
Six heavy loads							
7	22	1	14	6,300	108.5	118.9	450.0
8	19	1	20	6,300	108.5	118.9	315.0
9	19	1	28	6,400	109.3	120.8	228.5
10	17	1	24	5,695	111.4	123.8	237.3
11	29	3	14	6,860	115.8	140.0	490.0
12	24	2	14	7,355	119.8	150.1	525.4

inefficient. But the trip made by truck 2 was much more wasteful of transportation resources than that made by truck 1. Truck 2 traveled 27 miles to pick up one 400-pound hog and consequently hauled only 15 pounds of livestock per mile, while truck 1 traveled only 3 miles to pick up one 260-pound hog and hauled 87 pounds of livestock per mile.

Trips made by trucks 2 and 3 in table 5 also were extremely inefficient. Truck 2 made a 28-mile round trip to pick up one 500-pound animal and hauled only 18 pounds of livestock per mile, while truck 3 made a 36-mile round trip to pick up one animal weighing 1,000 pounds and hauled only 28 pounds per mile. The trip made by truck 1 in table 5 was more efficient than any of the trips made by trucks 2 to 6, inclusive, not because of size of load hauled, but because of the relatively short distance covered.

On the other hand, the weight of livestock hauled per mile is not a satisfactory measure of efficiency in the case of capacity loads, except when comparisons are being made between trucks of the same size rendering identical services. For example, truck 11 in table 5 hauled only 220 pounds of livestock per mile while truck 7 hauled 1,750 pounds. Since both trucks were loaded above normal capacity, the trip made by truck 11 was just as efficient as that made by truck 7, provided the longer trip was necessary. If the longer trip involved unnecessary mileage, or reached out into an area that could have been served more efficiently by a trucker in that area, it would be an example of wasteful use of transportation resources even though the truck was fully loaded.

The percent net-capacity also is an important measure of efficiency for less-than-capacity loads because it shows the relationship between the load hauled and the carrying capacity of the truck. That is, the percent net-capacity indicates whether the size of truck used is in keeping with the weight of livestock hauled. For example, trucks 3, 4, and 5 in table 5 each hauled 1,000 pounds of livestock, but the percent net-capacity varied from 11 percent for truck 3, to 20 percent for truck 5. While the trucks were loaded too lightly in each case, truck 5 was smaller and hence better adapted to the task than

Table 5. Relationship between Percent Gross-capacity, Percent Net-capacity, and Weight of Livestock Hauled per Mile, on Selected Trips Made by Martin County X Trucks to Pick Up Cattle Only, Martin County, August 2-8, 1942

Truck No.	Number cattle picked up	Number of stops	Miles round trip	Weight picked up	Percent of O.D.T. capacity		Weight of livestock hauled per mile
					Gross	Net	
				Pounds			Pounds
Six light loads							
1	1	1	2	600	45.8	6.7	300.0
2	1	1	28	500	53.4	8.3	17.9
3	1	1	36	1,000	48.4	11.1	27.8
4	1	1	12	1,000	51.9	13.3	83.3
5	1	1	6	1,000	68.5	20.4	166.7
6	1	1	12	1,000	68.5	20.4	83.3
Six heavy loads							
7	10	1	4	7,000	104.2	107.7	1,750.0
8	10	1	4	7,000	104.2	107.7	1,750.0
9	14	1	28	7,500	108.5	115.4	267.8
10	9	1	11	6,500	110.2	122.6	590.9
11	12	1	34	7,500	118.6	141.5	220.6
12	8	2	22	7,740	122.9	158.0	351.8

truck 4, and truck 4 was slightly better adapted than truck 3.

In the case of capacity loads, the percent gross-capacity is usually a more useful measure of efficiency than percent net-capacity or than pounds of livestock hauled per mile, because it gives the relationship between actual tire load and normal tire capacity. However, except in the case of identical trucks, this measure ordinarily is not as useful for light loads as the percent net-capacity, because the relationship between the empty and loaded weight of a truck varies somewhat among trucks of the same general type, and varies greatly among trucks of different types. In a study which included different types of vehicles unloading livestock at various types of markets in Minnesota in July, 1942, it was found that the tires of commercial semitrailers carried an average of 48 percent gross-capacity when the trucks were empty; commercial standard trucks, 51 percent; farm pickup trucks, 76 percent; and farm automobile trailers, 30 percent. The effect of variations in size of trucks on percent gross-capacity is revealed in the data for trucks 1, 2, and 3 in table 4. The percent gross-capacity was less for truck 3 than for truck 2, and less for truck 2 than for truck 1, but the actual weight hauled and percent net-capacity ranked in the opposite order.

Variations in size and type of trucks, together with the usual variations in routes traveled and services rendered on individual trips, make it impracticable to use any one efficiency measure for all conditions. In some cases, pounds of livestock hauled per mile is most useful, in others the percent net-capacity, and in still others the percent gross-capacity. In many cases, all three factors will be useful in deciding as to relative efficiency in the use of trucks which do not vary greatly with respect to size and which are engaged in rendering somewhat similar service.

Efficiency standards or goals, expressed in terms of one or more of these efficiency factors, can be readily established for identical trucks operating between any given origin and destination points. The goals or standards will vary with the size of the truck, with the species and class of livestock, with the density of the

livestock population, with the season of the year, and with weather and road conditions.

It does not necessarily follow that all loads below capacity should or could be eliminated, or that all trips on which the trucks are fully loaded are efficient. On occasion it may be necessary to move a breeding animal or a work horse rather promptly from one farm to another in the community, and it may not always be practicable to pick up other animals on the return trip. It may be more economical to make a round trip of several miles to pick up one or a few animals to complete a load that has been assembled for the distant market, than to incur the expense and shrink that would result from delaying the pickup trip until a full pickup load is available, or from transporting the market load at less than capacity. The stress and strain of stopping a fairly well-loaded truck near the end of a local assembly trip may be more wasteful of transportation resources than to make a special trip of a few miles.

The mere fact a truck was loaded to capacity when hauling livestock to a distant market does not, in all cases, answer the question as to whether it rendered efficient transportation service. For example, the roundabout trucking of slaughter animals through one or more markets on their way to slaughtering plants does not represent efficient use of transportation facilities. The same is true in regard to transporting feeding and breeding animals to distant markets and subsequently returning them to the same or nearby community. Unless the movement is in the direction of the place of slaughter, or in the direction of the farms where the feeding or breeding animals are to be unloaded, the effectiveness of the service is subject to question.

It usually is not practicable for a truck engaged in the local hauling of livestock to haul a full load on both the outbound and inbound trips. The truck commonly starts empty, and either picks up and delivers breeding or work animals in the country, or picks up animals at one or more stops en route, before returning to the point of origin. On the other hand, trucks engaged in hauling livestock to distant packing plants and other markets could haul return loads instead of returning empty, provided return freight is available and provided further that truck regulations permit. It is obvious that a truck loaded to capacity on both the outbound and inbound trips is rendering more total transportation service than if it is obliged to return empty, that is, provided the market trip does not involve the roundabout movement of the animals, or the return trip the roundabout movement of other products.

The problem is one of balancing transportation efficiency against marketing efficiency. It is desirable that livestock be marketed when they are ready for market and when the market is favorable. However, this excuse should not be used to justify inefficient hauling.

Operations of Commercial Livestock Trucks

SEVENTY-ONE of the 123 commercial livestock and general trucks made one or more trips in Martin County with livestock during the week of August 2-8, 1942 (table 6). Of these, 57 were located in Martin County and 14 outside. The Martin County trucks included 31 with Minnesota X licenses and 26 with Minnesota Y licenses, while the trucks located outside the county included 9 Minnesota X trucks, 3 Minnesota Y trucks, and 2 Iowa trucks. In the subsequent discussion and accompanying tables, unless otherwise stated, the Iowa trucks are included with the Minnesota X trucks located outside Martin County because of similarity in the nature of trips and weight of livestock hauled.

Number of Trucks Hauling Livestock

The number of trucks engaged in hauling livestock on different days of the week varied greatly. Among the 31 Martin County X trucks, the number varied from 4 to 20 per day with an average of about 11. Among the 26 Martin County Y trucks, the number varied from 2 to 15 per day with an average of 9. The number of Martin County X and Y trucks combined varied from 6 to 35 per day with an average of slightly over 19.

Number of Trips with Livestock

The 31 Martin County X trucks made a total of 158 trips with livestock, or an average of slightly more than 5 trips per truck, during the week (table 7).[6] The number of trips on different days of the week varied from 4 to 44 with an average of 23. The 26 Martin County Y trucks made a total of 81 trips, an average of 3 per truck. The number of trips per day by this group varied from 2 to 20, averaging slightly less than 12. The 57 Martin County X and Y trucks together made 239 trips with livestock, an average of slightly more than 4 per truck. Trips per day for both groups combined varied from 6 to 64 with an average of 34. The 14 outside trucks together made only 20 trips in Martin County with livestock during the week, an average of slightly less than 3 per day.

Other Products Hauled

The figures presented in tables 6 and 7 indicate that the number of Martin County trucks in which some livestock was hauled during the week of the study was far in excess of the number required. Furthermore, several additional Martin County trucks were equipped to haul livestock but were not so used during the week (see page 5). However, the movement of livestock to market from Martin County during early August is commonly much less than during other seasons. For example, hog production is an important enterprise in this county, and the peak in hog marketings usually occurs in December and January when the spring pigs have reached the desired weight and condition. Relatively few hogs are mar-

[6] Each trip with livestock involved the round trip from point of origin to destination and back to point of origin. Return loads are reported as such and not as separate trips. Likewise, each trip reported in the section, "Other Products Hauled," involved the round trip from the point of origin to destination and back to point of origin. A number of trucks were engaged in hauling grain, as threshing was in progress during the week. Each trip from the elevator to the threshing machine and back to the elevator is reported as a single round trip.

Table 6. Number of Commercial Trucks Hauling Livestock within, into, or out of Martin County, During the Week of August 2-8, 1942

Location of truck and type of license	Number of trucks		
	Total	Per day	
		Range	Average
Martin County X	31	4-20	10.6
Other Minnesota X	11*	1-5	2.1
Total Minnesota X	**42**	**5-23**	**12.7**
Martin County Y	26	2-15	8.9
Other Minnesota Y	3	0-1	0.4
Total Minnesota Y	**29**	**3-15**	**9.3**
Martin County X and Y	57	6-35	19.4
Other Minnesota X and Y	14	1-6	2.6
Total Minnesota X and Y	**71**	**8-38**	**22.0**

* Includes two Iowa trucks.

keted in early August, and the movement of cattle also is lighter than at other seasons. It is important, of course, that transportation facilities be adequate to handle the movement at its peak.

Furthermore, data concerning the hauling of livestock alone do not give a complete picture of the use made of all these trucks during the week. For example, of the 31 Martin County X trucks which made 158 trips with livestock during the week, 3 hauled livestock only, while 28 also hauled other products. The three mentioned made a total of 35 trips with livestock, or an average of 11.7 trips each. The other 28 trucks made 181 trips hauling grain and 28 trips hauling other products, or a total of 209 trips in addition to the 123 trips with livestock. Thus these 28 trucks made a total of 332 trips, an average of 11.8 each. As the 31 Martin County X trucks which hauled one or more loads of livestock during the week made 158 trips with livestock and 209 trips with other products, they made an average of 5.1 trips per truck with livestock, and 6.7 trips per truck with other products, or an average of 11.8 trips with livestock and other products.

In making the 209 trips with grain and other products, the 28 Martin County X trucks traveled a total of 2,680 miles and reported 1,906,500 pounds of products hauled. Weight hauled on 9 of the trips was not reported. The weight of these products was much greater than the weight

Table 7. Number of Trips Made by Commercial Trucks Hauling Livestock within, into, or out of Martin County, During the Week of August 2-8, 1942

Location of truck and type of license	Number of trucks	Total trips	Average trips per truck	Trips per day	
				Range	Average
Martin County X	31	158	5.1	4-44	22.6
Other Minnesota X	11*	17†	1.6	1-6	2.4
Total Minnesota X	**42**	**175**	**4.2**	**5-48**	**25.0**
Martin County Y	26	81	3.1	2-20	11.6
Other Minnesota Y	3	3	1.0	0-1	0.4
Total Minnesota Y	**29**	**84**	**2.9**	**3-20**	**12.0**
Martin County X and Y	57	239	4.2	6-64	34.1
Other Minnesota X and Y	14	20	1.4	1-7	2.9
Total Minnesota X and Y	**71**	**259**	**3.6**	**8-68**	**37.0**

* Includes two Iowa trucks.
† Includes three trips by two Iowa trucks.

Table 8. Number of Head of, and Weight of, the Various Species of Livestock Transported in Minnesota X and Y Trucks, Martin County, August 2-8, 1942

Species	Minnesota X		Minnesota Y		Minnesota X and Y	
	Number of head	Weight	Number of head	Weight	Number of head	Weight
		Pounds		Pounds		Pounds
Hogs	1,705	498,685	1,672	489,915	3,377	988,600
Cattle	241	184,434	384	350,099	625	534,533
Calves	28	5,925	21	3,650	49	9,575
Sheep	29	2,723	6	390	35	3,113
Horses	21	30,726	.....	.....	21	30,726
Mixed species	.....	17,000	.....	17,000	.....	34,000
Total	**2,024**	**739,493**	**2,083**	**861,054**	**4,107**	**1,600,547**

of livestock transported by all Martin County and other Minnesota X trucks (table 8), while the distance traveled was somewhat less (table 9).

On the other hand, of the 26 Martin County Y trucks which hauled livestock during the week, only 10 also hauled other products. These 10 trucks made 37 trips hauling grain and 20 trips hauling other products, or a total of 57 trips in addition to 33 trips with livestock. Consequently, these trucks made an average of 3.3 trips with livestock, plus 5.7 trips with other products, or a combined average of 9 trips. This compared with an average of 3 trips each for the other 16 Martin County Y trucks which hauled livestock only.

In making the 57 trips with grain and other products, the 10 Martin County Y trucks traveled 3,309 miles and reported 453,941 pounds of products hauled, in addition to the weight hauled but not reported on one trip. It is apparent that this type of business was of considerable importance for a relatively small proportion of the Y trucks, but for all Y trucks combined it was relatively less important than for the X trucks (tables 8-9).

Volume of Livestock Hauled

The 71 Martin County and other Minnesota X and Y trucks combined hauled within, into, or out of Martin County during the week of the study a total of 4,107 head of livestock in addition to 34,000 pounds reported merely as livestock without designating the species (table 8).[7] In this number were 3,377 hogs, 625 cattle, 49 calves, 35 sheep, and 21 horses. Slightly more hogs, but only about two thirds as many cattle, were transported in Minnesota X as in Minnesota Y trucks. All of the relatively small number of horses, most of the small number of sheep, and over half of the small number of calves were hauled in the Minnesota X trucks. The combined weight of the hogs was nearly twice that of cattle, and the hogs and cattle together comprised the greater part of the total.

The weight of livestock hauled on different days of the week is shown by location of trucks and by type of license in figure 1. A total of 1,600,547 pounds of livestock were hauled within, into, or out of Martin County by all of the Minnesota X and Y trucks.

[7] Many of the animals were assembled locally in X and Y trucks and subsequently transported to distant market outlets in Y trucks. In addition, a few were assembled locally and subsequently distributed locally. Consequently, many animals were involved in more than one trip, and as the number and weight hauled on each trip are included in the figures reported in table 8 and figure 1, there is considerable duplication in both the number and weight of livestock hauled during the week.

Table 9. Miles Traveled by Martin County and Other Minnesota X and Y Trucks Hauling Livestock within, into, and out of Martin County During the Week of August 2-8, 1942

Location of truck and type of license	Number of trips	Miles traveled					
		Total			Average per trip		
		Total	In Martin County	Outside Martin County	Total	In Martin County	Outside Martin County
Martin County X	158	2,846	2,271	575	18.0	14.4	3.6
Other Minnesota X	17	490	179	311	28.8	10.5	18.3
All Minnesota X	**175**	**3,336**	**2,450**	**886**	**19.1**	**14.0**	**5.1**
Martin County Y	81	15,449	2,634	12,815	190.7	32.5	158.2
Other Minnesota Y	3	518	68	450	172.7	22.7	150.0
All Minnesota Y	**84**	**15,967**	**2,702**	**13,265**	**190.1**	**32.2**	**157.9**

Of this amount, the 31 Martin County X trucks hauled 684,528 pounds, and the 26 Martin County Y trucks hauled 825,814 pounds. The 14 outside trucks together hauled only 90,205 pounds, or less than 6 percent of the total.

The combined weight of livestock hauled by all trucks varied greatly from day to day during the week. About 27 percent of the total was hauled on Thursday, 21 percent on Monday, 14 percent on Tuesday, 13 percent on Friday, nearly 13 percent on Wednesday, over 9 percent on Saturday, and 3 percent on Sunday.

Distance Traveled

The Martin County and other Minnesota X trucks traveled a total of 3,336 miles hauling livestock within, into, or out of Martin County during

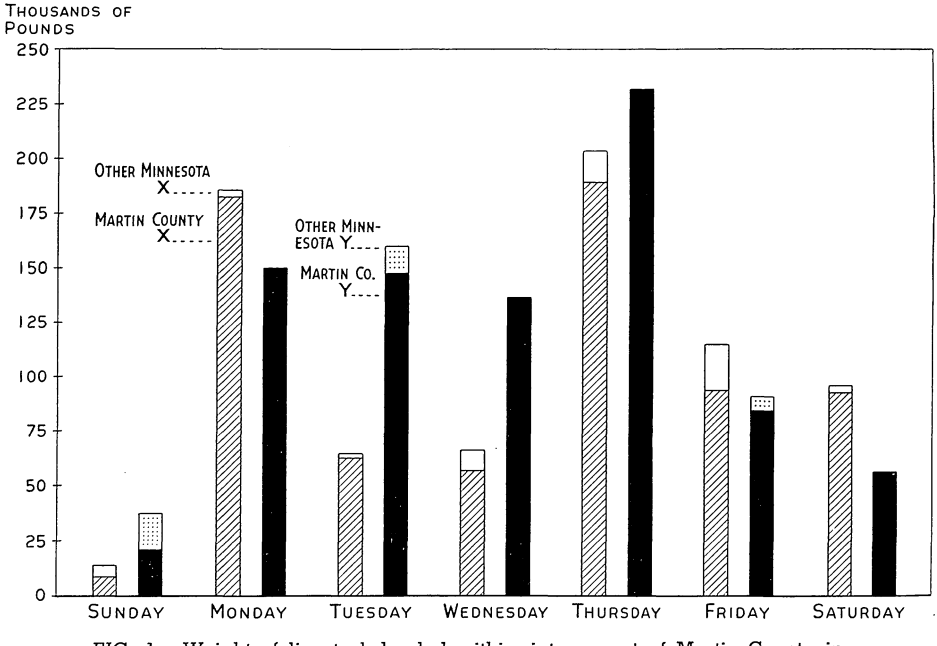

FIG. 1. Weight of livestock hauled within, into, or out of Martin County in commercial livestock trucks, classified by location and type of license, each day during week of August 2-8, 1942.

the week of the study (table 9). Of this amount, 2,450 miles were traveled in Martin County and 886 miles outside the county. The average trip covered 19 miles, of which about 14 miles were in Martin County and 5 miles were outside. The shortest trip covered only 2 miles; the longest, 147 miles. It will be observed that the X trucks located outside Martin County averaged more miles per trip, with a higher proportion of travel outside Martin County, than did X trucks located in Martin County.

The Martin County and other Minnesota Y trucks traveled a total of 15,967 miles hauling livestock within, into, or out of Martin County during the week. Of this total, 2,702 miles were traveled in Martin County and 13,265 miles outside. Individual trips varied from 4 to 700 miles, the average being 190 miles, of which 32 miles were in Martin County and 158 miles outside. All Minnesota X and Y trucks combined traveled 5,152 miles in Martin County during the week of the study, when marketings were relatively light, or about 3.7 times the total highway mileage in the county.

Number of Pickup Stops

The number of pickup stops per trip made by Minnesota X trucks varied from 1 to 5 with an average of 1.26 per trip. As this relatively low average suggests, the majority of cases involved a stop at one farm only. In other words, the truck operators commonly responded promptly to the call of individual farmers regardless of location or number of animals to be picked up. The effect of this practice on size of loads and operating efficiency will be discussed later.

The Minnesota Y trucks made slightly more pickup stops per trip on the average than the Minnesota X trucks. For these trucks the number of pickup stops per trip varied from 1 to 6 with an average of 1.51. In many cases, the Y trucks were loaded at a central point where the animals had been assembled in X trucks. These were reported as single pickup stops. In some cases, full market loads were obtained at a single farm. Because of the distance to market, Y-truck operators make an effort to load at or near capacity, and this often involves more than one pickup stop when the animals are moved directly from farms to distant markets.

Average Size of Loads

Truck-operating methods during the week of the study were such that the trucks used for local hauling were not loaded as near to capacity as those used to transport livestock to distant markets and packing plants. On the average, Martin County X trucks were loaded at 63 percent net-capacity and slightly over 80 percent gross-capacity (table 10). The X trucks from outside Martin County hauled even lighter loads on the average—53 percent net-capacity and 76 percent gross-

Table 10. Size of Loads Hauled by Trucks Transporting Livestock within, into, and out of Martin County During the Week of August 2-8, 1942

Location of truck and type of license	Number of trucks	Number of trips	Average percent O.D.T. capacity	
			Gross	Net
Martin County X	31	158	80.2	62.5
Other Minnesota X	11	17	75.7	52.6
Total Minnesota X	**42**	**175**	**79.9**	**61.9**
Martin County Y	26	81	93.8	88.5
Other Minnesota Y	3	3	101.2	102.4
Total Minnesota Y	**29**	**84**	**94.0**	**89.0**

capacity. The average of the loads hauled by all Minnesota X trucks was 62 percent net-capacity and nearly 80 percent gross-capacity.

The Martin County Y trucks were loaded at an average of about 89 percent net-capacity and 94 percent gross-capacity. The other Minnesota Y trucks were loaded slightly above normal capacity, but the number of trips made by this group was too small to have much effect on the average for all Minnesota Y trucks combined.

Average Weight of Livestock Hauled Per Mile

An average of 240 pounds of livestock per mile was hauled on the 158 trips made by Martin County X trucks (table 11). This was slightly higher than the average weight of livestock hauled per mile by Martin County Y trucks making round trips of 100 miles or less, and considerably higher than for other Minnesota X trucks. The better showing of the Martin County X trucks was due chiefly to the fact that the average miles per round trip made by these trucks was considerably less than the average of other groups.

The range in pounds of livestock hauled per mile was much greater for the Martin County X trucks than for the other Minnesota X trucks, and somewhat greater for the other Minnesota X trucks than for Martin County Y trucks making round trips of 100 miles or less. This was due to wide variations both in weight of livestock hauled per trip and in distances traveled.

The effect of distance on weight hauled per mile also is indicated by the data for Martin County Y trucks traveling various distances. The greater the distance, the lower the weight of livestock hauled per mile. Here the variation between different distance zones is due chiefly to distance, although it was also affected by the size of the trucks and percent net-capacity hauled. The four trips in the Martin County Y group of 401 miles and over were made by the same truck, from the same point of origin to the same destination, with the same species of livestock. Here the variations in pounds of livestock hauled per mile were due entirely to the net weight of the livestock hauled per trip.

Variation in Size of Loads

Figures showing the average weight of loads hauled and average distance traveled do not reveal the wide variations in the individual loads. Some loads of both Minnesota X and Minnesota Y trucks were extremely light and others were in excess of normal capacity.

Table 11. Weight of Livestock Hauled per Mile by Trucks, Classified According to Location and Type of License, Martin County, August 2-8, 1942

Location of truck and type of license	Number of trips	Pounds of livestock hauled per mile		
		Average	High	Low
Martin County X	158	240.5	3,926.0	14.8
Other Minnesota X	17	112.2	637.5	18.8
Martin County Y				
100 miles or under	32	214.6	590.6	17.9
101-250 miles	14	80.9	127.4	62.9
251-400 miles	31	44.4	67.1	10.9
401 miles and over	4	25.4	27.1	23.7
Other Minnesota Y				
100 miles or under	1	209.7	209.7	209.7
101-250 miles	1	75.5	75.5	75.5
251-400 miles	1	51.0	51.0	51.0

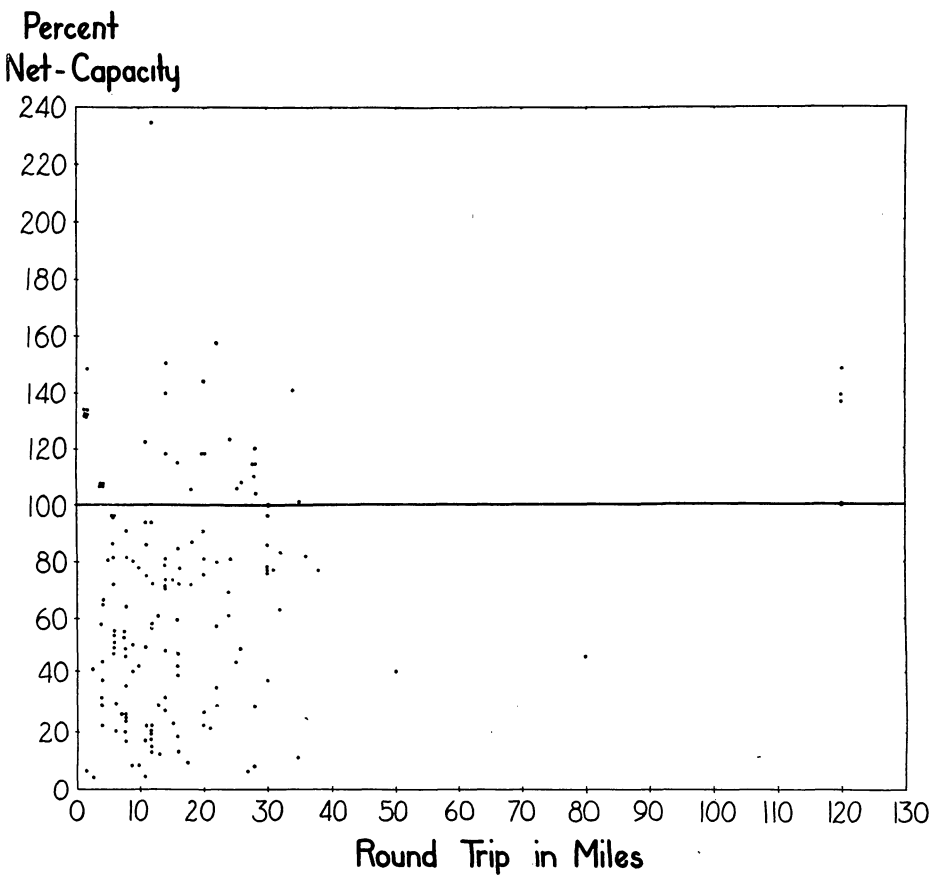

FIG. 2. Relationship between percent net-capacity and distance traveled by Martin County X trucks in making 158 trips with livestock during the week of August 2-8, 1942.

Each dot represents a separate trip. The location of the dot on the horizontal scale indicates the number of miles in the round trip. The location of the dot on the vertical scale indicates the size of the load in relation to the carrying capacity of the truck. It will be observed that most of the round trips involved distances of 38 miles or less, and that most of the loads were below, many of them far below, the normal carrying capacity of the trucks.

The relationship between the distance traveled and the percent net-capacity of all loads of livestock hauled by Martin County X trucks is shown in figure 2. Of the 158 trips made by these trucks, 152 involved round trips of from 2 to 38 miles, one of 50 miles, one of 80, and four of 120 each. The small number of trucks which made the 120-mile round trips were all loaded at or above normal capacity. On the other hand, there appears to be little correlation between weight hauled and distances traveled on the other 154 trips. The percent of net-capacity hauled on these trips varied from 5 to 235. Loads of less than 20 percent net-capacity and loads of over 140 percent net-capacity were hauled by trucks making round trips of 0-10 miles, 10-20 miles, 20-30 miles, and 30-40 miles. The two trucks which

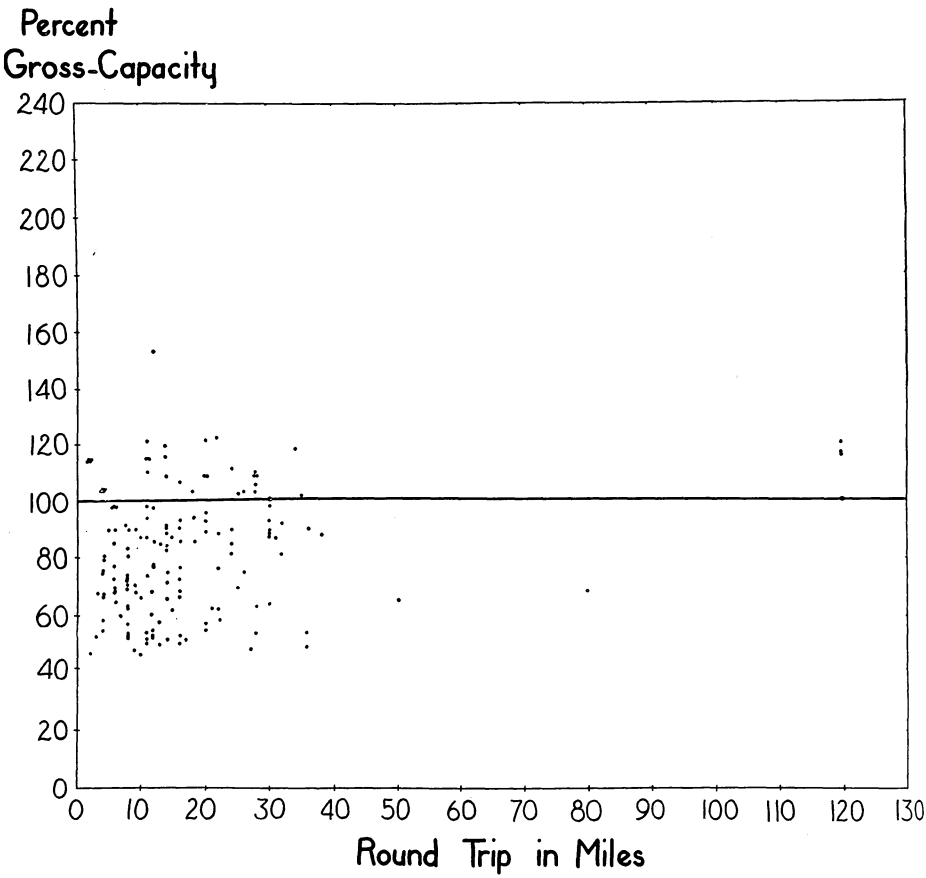

FIG. 3. Relationship between percent gross-capacity and distance traveled by Martin County X trucks in making 158 trips with livestock during the week of August 2-8, 1942.

This diagram is similar to figure 2, except that the distance in each round trip is related to the percent gross-capacity instead of percent net-capacity.

made 50- and 80-mile round trips, respectively, were loaded at less than 50 percent net-capacity.

The data presented in figure 3 are the same as in figure 2 except that distance is plotted against the percent of gross-capacity instead of the percent of net-capacity. Variations in percent of gross-capacity are much less extreme than the variations in net-capacity. Relatively few trucks were loaded in excess of 120 percent of gross-capacity. Only one was loaded far in excess of normal gross-capacity and this involved a round trip of only 12 miles, or only 6 miles after loading.

The relationship between the percent net-capacity and distance traveled on each round trip by Martin County Y trucks is shown in figure 4. In figure 5 the same trips are plotted against percent of gross-capacity hauled. Of a total of 81 trips, 32 involved round trips of from 5 to 46 miles. Trucks making these trips not only traveled short distances, but were all loaded

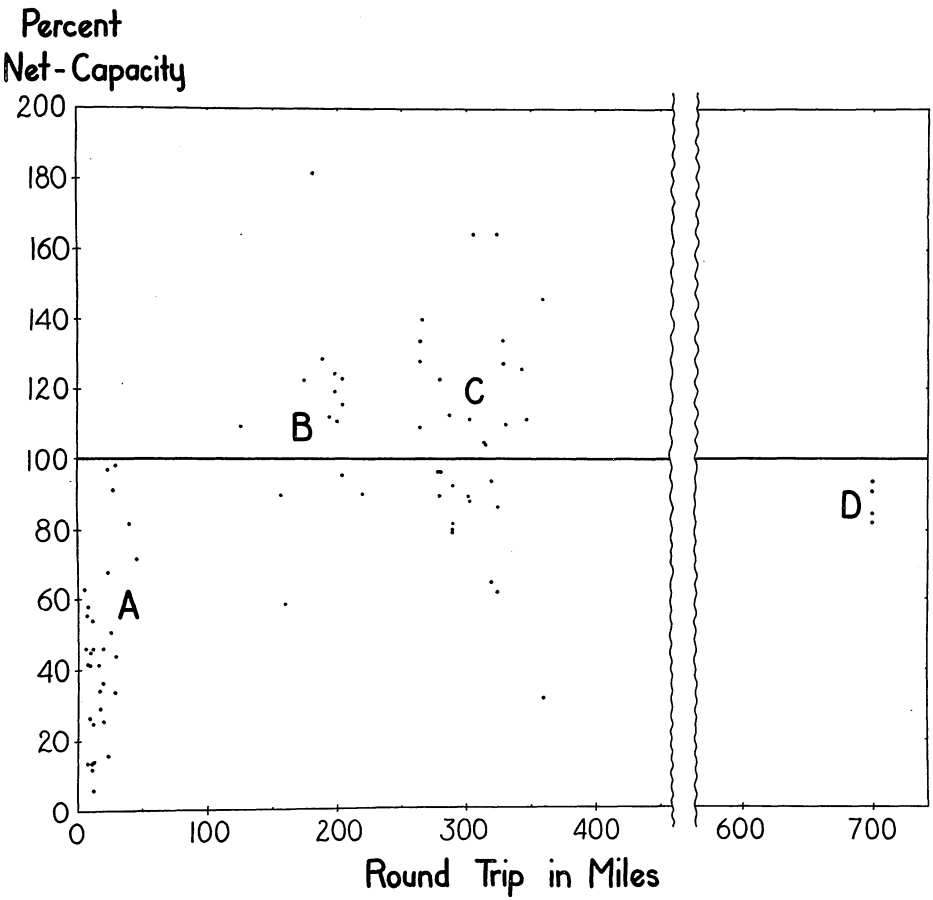

FIG. 4. Relationship between percent net-capacity and distance traveled by Martin County Y trucks in making 81 trips with livestock during the week of August 2-8, 1942.

The dots grouped around A, in the lower left-hand corner of the diagram, represent local round trips of 46 miles or less. Dots grouped around B represent trips to packing plants at Austin and Albert Lea, Minnesota; those grouped around C represent trips to the public stockyards at South St. Paul and to a packing plant at Newport, Minnesota; and those grouped around D represent trips to a packing plant at Madison, Wisconsin.

at less than normal capacity, the range being from 6 percent to 98 percent of net-capacity (figure 4). Consequently, the dots for these trips are all located in the lower left-hand corner of the diagram, in the area designated "A."

A second group of trips (area B) involved round-trip distances of 120 to 220 miles, a third group (area C) involved round-trip distances of 250 to 360 miles, and a fourth group (area D) involved round-trip distances of 700 miles each. Trips shown in area B were to packing plants at Austin and Albert Lea, Minnesota. Trips shown in area C were made to the public market at South St. Paul and to a packing plant at Newport, Minnesota. Trips shown in area D were made to a packing plant at Madison, Wisconsin.

Variations in distances traveled by Martin County trucks to the same des-

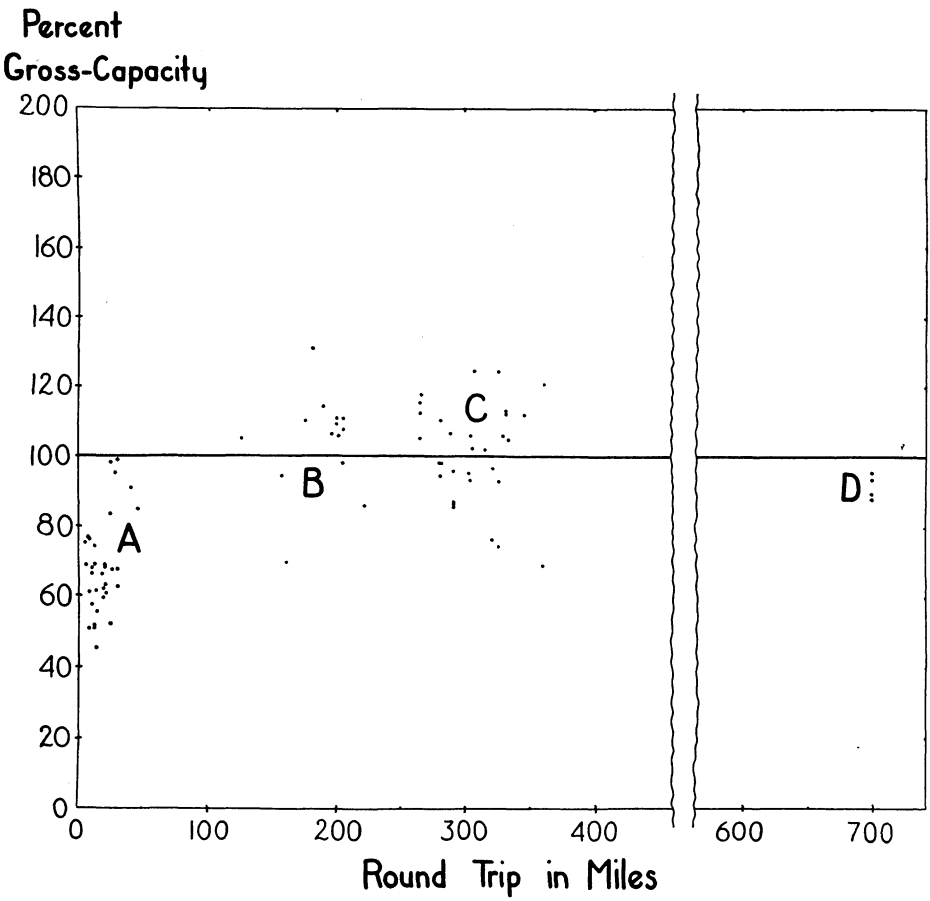

FIG. 5. Relationship between percent gross-capacity and distance traveled by Martin County Y trucks in making 81 trips with livestock during the week of August 2-8, 1942.

This diagram is similar to figure 4 except the distance traveled in making each round trip is related to the percent gross-capacity instead of percent net-capacity.

tination are due to two factors: First, the point of origin within the county was not the same for all trucks, and second, some trucks traveled extra mileage to pick up animals on farms en route to the market place.

Out of 14 trips to packing plants in area B (figure 4) four were loaded at less than 100 percent net-capacity, one of these being loaded at less than 90 percent net-capacity. Of the 31 trips to markets in area C, 14 were loaded at less than 100 percent net-capacity, nine of these at less than 90 percent of net-capacity, and four at less than 80 percent. The truck that made the four 700-mile round trips to area D was loaded between 82 and 94 percent of net-capacity.

It is apparent that Martin County Y trucks hauled much heavier average loads in over-the-road movement of livestock to distant packing plants and markets than in local hauling. Whereas all of the Y trucks, when engaged in local hauling of livestock,

were loaded below 100 percent net-capacity, and in most cases loaded far below capacity, over two thirds of the loads hauled to packing plants in area B and over one half of those hauled to markets in area C were loaded at or above 100 percent net-capacity. The trucks were loaded at less than 100 percent net-capacity on 22 of the 49 trips to areas B, C, and D. Seventeen of these below-capacity trips involved loads of 80 percent or more of net-capacity, while five involved trips of less than 80 percent net-capacity.

Variation in Number of Animals Hauled Per Trip

The large number of light loads shown in figures 2 and 3 and in the A areas of figures 4 and 5 suggests that many round trips were made to pick up single animals or a relatively small number of animals. A study of the individual trip records confirms this.

Of the 158 trips made by Martin County X trucks, 138 were made to pick up one class of livestock only and 17 were made to pick up mixed species. For three trips the species were not reported (table 12). Two round trips were made to pick up one hog each, six trips were made to pick up one head of cattle each, and three trips were made to pick up one horse each. Two trips were made to pick up two hogs each, two were made to pick up two head of cattle each, and five were made to pick up two horses each. The number of hogs picked up per trip varied from 1 to 37, and of cattle from 1 to 14.

Of the 81 trips made by the Martin County Y trucks, 71 were made to

Table 12. Number of Trips, and Number of Animals Picked Up per Trip, by Martin County X and Y Trucks, When One Species Only Was Picked Up, August 2-8, 1942

Number picked up per trip	Number of trips by Martin County trucks						
	Minnesota X license					Minnesota Y license	
	Hogs	Cattle	Calves	Sheep	Horses	Hogs	Cattle
1	2	6	.....	.....	3	3	2
2	2	2	.....	.....	5	.....	5
3	1	3	.....	.....	.....	2	.....
4	4	1	.....	.....	1	1	.....
5	1	1	.....	.....	.....	1	.....
6	2	.....	1	1	.....	3	.....
7	1	2	.....	1	.....	1	1
8	5	2	.....	.....	.....	2	1
9	3	3	.....	.....	.....	.....	.....
10	7	10	.....	.....	.....	.....	1
11	7	.....	.....	.....	.....	.....	.....
12	5	1	.....	.....	.....	1	4
13	3	.....	.....	.....	.....	1	1
14	2	1	.....	.....	.....	1	3
15	9	.....	.....	.....	.....	.....	.....
16	6	.....	.....	.....	.....	.....	4
17	8	.....	.....	.....	.....	.....	.....
18	1	.....	.....	.....	.....	.....	.....
19	4	.....	.....	.....	.....	2	.....
20	3	.....	.....	.....	.....	.....	2
21	.....	.....	.....	.....	.....	.....	1
22	3	.....	.....	.....	.....	2	1
23	.....	.....	.....	.....	.....	.....	.....
24	2	.....	.....	.....	.....	.....	.....
25 or over	13	.....	.....	.....	.....	24	1
Total	**94**	**32**	**1**	**2**	**9**	**44**	**27**

pick up one species only, nine to pick up mixed species, with the species unreported on one trip. Three trips were made to pick up one hog each, and two to pick up one head of cattle each. The number of hogs picked up varied from 1 to 80, and of cattle from 1 to 27. No horses were hauled during the week in Martin County Y trucks, and the few veal calves and sheep were hauled with other species.

Making special trips to pick up single animals or small lots results in trucks being loaded below normal capacity.

Overlapping and Crosshauling

Examples of overlapping trips on the part of truckers in the same community, and of overlapping and crosshauling on the part of truckers in nearby communities, are shown in figures 6 and 7. The origin and destination of each local and each long distance trip and the kind and number of animals picked up or transported also are shown.

All trips made with livestock by Martin County X and Y trucks, and all trips made with livestock in Martin County by outside trucks, on Thursday, August 6, 1942, are shown in figure 6, and all such trips made on the following two days are shown in figure 7. Each community has its own symbol used for all truckers in that community. Still another symbol is used for all trucks from outside the county. The same symbol plan is followed in both figures. The route of

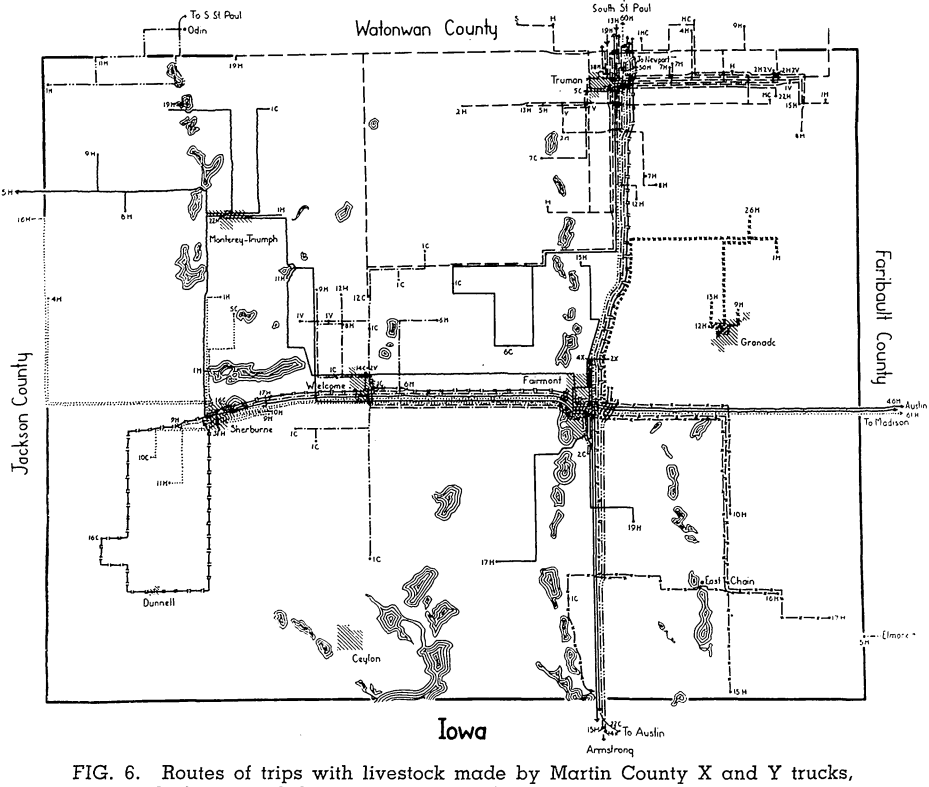

FIG. 6. Routes of trips with livestock made by Martin County X and Y trucks, and of trips with livestock made in Martin County by outside trucks, on Thursday, August 6, 1942.

a given truck trip is shown by a single line, that is, a separate line is not shown for the return trip when made over the same road as the outgoing trip. All pickup stops are shown, together with the kind and number of animals picked up. Hogs are designated by the letter H, cattle by C, calves by V, sheep by S, and horses by X.

It will be observed that the same truckers or different truckers from the same town often made trips into the same community on the same day or during the three days covered by figures 6 and 7. In some cases, full loads were picked up at one or more stops, but many trips were made to pick up small lots of animals. Truckers from a given town often drove near or beyond another trucking center to pick up one or a few animals. Considerable overlapping occurred in trips made by truckers from different communities. Some relatively long trips were made to pick up only one or two animals.

A considerable number of the long-distance trips on Thursday (figure 6) were made to the public stockyards at South St. Paul, while on the next two days (figure 7) most of the long-distance trips were made to packing plants in Minnesota and Wisconsin.

Return Loads

Return loads, or "back hauls," were obtained on a relatively small proportion of the long-distance or market trips made with Martin County Y trucks during the week of the study. Of the 49 long-distance trips made by

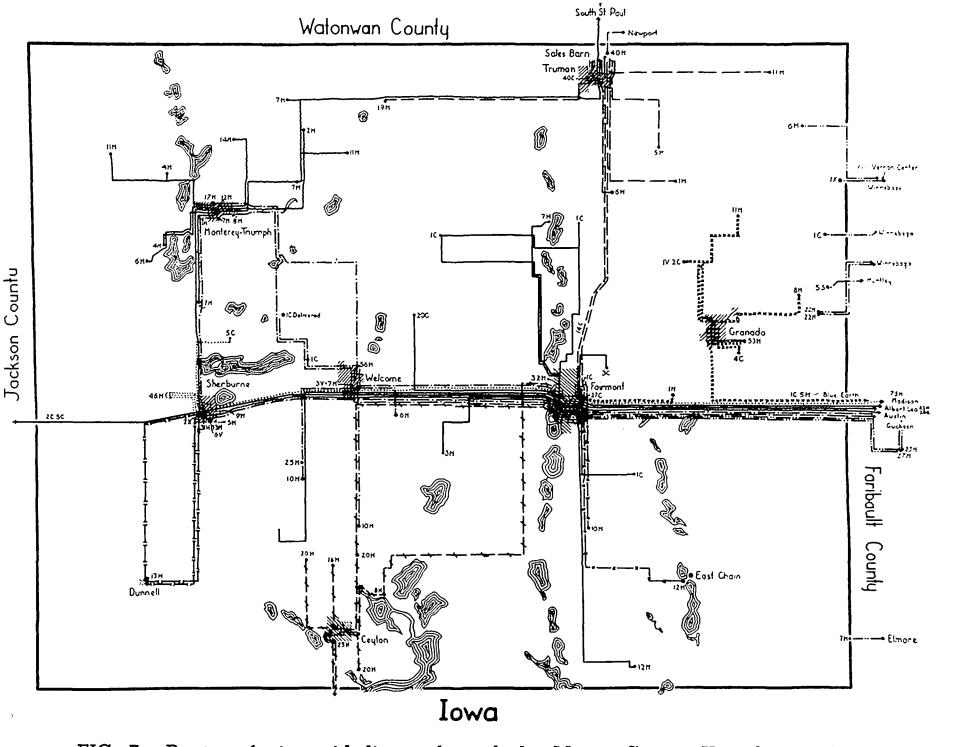

FIG. 7. Routes of trips with livestock made by Martin County X and Y trucks, and of trips with livestock made in Martin County by outside trucks, on Friday and Saturday, August 7 and 8, 1942.

these trucks, 27 were made to the public market at South St. Paul, and 22 direct to packing plants. Return loads were obtained on nine of the trips to South St. Paul, and on only one of the trips direct to packers. Three of the trucks that unloaded livestock at South St. Paul returned with over 100 percent capacity loads of beer, three with near-capacity loads of livestock, one with a small load of tankage, one with a moderate and one with a light load of machinery. The back haul on the one trip direct to a packing plant consisted of a moderate load of livestock picked up en route and unloaded at point of origin.

Two-way loads were even less common in the case of trips made with Martin County X trucks and in the case of local trips made with Martin County Y trucks. Of the 158 trips made with livestock by Martin County X trucks, only four involved two-way loads, and in three of these cases the extra amount hauled was relatively unimportant—200 pounds of machinery repair parts in one case, 700 pounds of gravel and cement in another, a 530-pound bull in the third instance. In only one case were reasonably full loads hauled both ways. Two-way loads were hauled on only one of the 32 local trips made with livestock by Martin County Y trucks, the return load being 540 pounds of buttermilk.

Regulations on Return Loads

Under Minnesota laws and regulations, trucks used to transport livestock for hire beyond a 35-mile radius of the point of registration are classified as irregular route common carriers.[8] This includes trucks operating under Minnesota Y licenses. Such a classification rests upon the assumption that the routes followed in making local pickup stops, in preparation for outbound trips to distant packing plants and other markets, may vary from trip to trip, and, consequently, the trucks do not commonly operate entirely between fixed terminals. This regulation also could be interpreted as limiting return loads or back hauls to the delivery of supplies to individual farmers and others in the rural communities from which the livestock are drawn. However, the custom which has developed over a period of time also permits the delivery of commodities to the towns and villages in which the truckers make their headquarters, and to creameries, elevators, and cooperative stores at inland villages.[9] The only legal limitation on return loads in effect at present is that irregular route common carriers cannot be used to transport for hire "food for human consumption nor any article or package containing any property intended for, or that could be used in, any household," after hauling livestock, unless the trucks have been "thoroughly cleaned."[10]

In an effort to bring about greater efficiency in the use of trucks during the existing emergency, the Office of Defense Transportation has authorized the "establishment of Joint Information Offices" at such points and places in the United States as it may approve.[11] The principal objective of such organizations is to avoid situations whereby city trucks hauling to the country and country trucks hauling to the city both return empty or partly empty.

[8] Chapter 170, Session Laws 1933, as amended, State of Minnesota Railroad and Warehouse Commission, 401 State Office Building, St. Paul, Minnesota, page 1.

[9] Information supplied by R. L. Norgaard, State of Minnesota Railroad and Warehouse Commission, April 19, 1943.

[10] Chapter 170, Session Laws 1933, as amended, pages 4-5.

[11] General Order O.D.T. No. 13. Part 501—Conservation of Motor Equipment, Subpart I—Establishment of Joint Information Offices, July 2, 1942.

Improving Truck Efficiency

THIS study has revealed considerable inefficiency in the use of trucks to transport livestock both locally and to distant markets and packing plants. While the data are limited to truck operations in a single county, for a period of one week when the movement of livestock was relatively light, it is believed that the results have fairly general application both as to time and place. Activity of both the local and distant movement varies from season to season, and from species to species during a given season. It is probable also that seasonal variations occur in the proportion of different species transported to the various destinations. However, these variations are largely of degree rather than of kind. In fact, it is probable that the situation, at least with respect to the local assembly of livestock, has been even less efficient in parts of Minnesota where livestock production is relatively less important than in Martin County.

Specific Suggestions

Some suggestions for improving the operating efficiency of trucks used to transport livestock apply largely or entirely to local hauling, others to the movement to distant markets, while others apply to both. This is indicated by the grouping of the suggestions which follow:

Suggestions which apply largely to local hauling:

1. Route trucks with the aim of picking up as near capacity loads as possible on each local assembly trip and of avoiding special trips for single animals or small lots. This may require limiting pickup service in a given community to a specified day or days, depending upon volume available.

2. Arrange to transport breeding animals or others from local markets to the farms, or from farm to farm, in connection with trips to pick up animals for market.

3. Fit the truck to the task. Use smaller trucks on local pickup trips where loads are light, and for local hauling. Use larger trucks for longer distances.

4. Avoid overlapping trips by truckers in the same community whenever this results in less-than-capacity loads or unnecessary truck mileage.

5. Avoid overlapping and crosshauling by truckers from nearby communities.

Suggestions which apply largely to long distance hauling:

6. Haul capacity loads from local markets or local assembly points to distant packing plants and other markets.

7. Eliminate local assembly trips whenever it is practicable to pick up capacity loads at one or more farms en route to distant packing plants and other markets. This will save time, reduce truck mileage, and hold tissue shrinkage at a minimum.

8. Transport each class, grade, and weight of livestock over the most direct route to the packing plant or other market which offers the highest net return to producers. Roundabout movement which entails unnecessary truck mileage should be avoided.

9. Obtain return loads whenever this is practicable.

10. Eliminate unnecessary travel such as transporting customers back to their

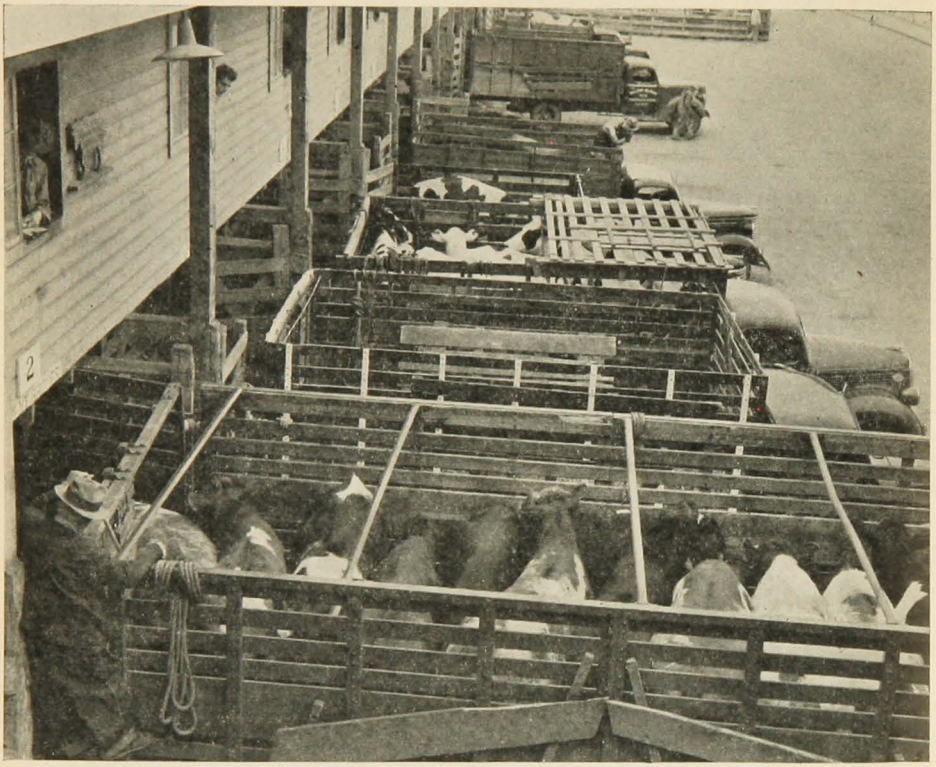

FIG. 8. Unloading livestock trucks at a stockyard.

farms, or delivering checks and receipts for livestock hauled.

11. In some cases it may be advisable to divert a higher proportion of the total over-the-road movement from trucks to the railroads. This will depend upon the relative convenience, cost, and effectiveness of the services rendered by each.

Suggestions which apply to both local and long-distance hauling:

12. Distribute marketings more evenly over the week. This study revealed considerable variation in the number of trucks in use per day, and number of trips made per day, during the week of the study, when marketings were relatively light, and this applied to trucks used for local hauling as well as trucks used for long-distance hauling.

Other studies also indicate wide daily fluctuations in the movement to packing plants and other markets during both slack- and peak-marketing periods. More even daily movement of livestock would enable fewer trucks to handle the same total volume of business and at the same time it would be advantageous to packing and market interests.

13. It is probable that somewhat greater use could be made of livestock trucks to transport other farm products or supplies during periods when the flow of livestock to market is relatively light.

Alternative Plans

The formulation and adoption of plans which will insure greater efficiency in the use of trucks engaged in local and long-distance hauling of livestock are not as simple as may at first appear. In the first place, there are many producers and hence many sellers of livestock. Whereas about 61 percent of the livestock marketed in 1919 by Minnesota farmers was forwarded to market, chiefly to public stockyards markets, through local cooperative shipping associations, only about 13 percent was so handled in 1936 when the last state-wide survey was made. The great majority of Minnesota farmers now sell their livestock as individuals, either locally or at distant public and private markets. They have been privileged to sell their livestock when and where they wish and to use whatever transportation facilities may be available.

In the second place, the ownership and operation of livestock trucks do not rest in a few hands as do some of the other means of transportation. In most Minnesota communities there are several independent truckers, each owning and operating one or more trucks.

This combination of many individual farm patrons and many independent truckers has led to the various inefficiencies pointed out in this bulletin. Farmers have become accustomed to calling the local truckers of their choice by telephone and asking them to drive to their farms to pick up a cow, a veal calf, a few hogs, or a full load, as the case may be. In most cases the farmer has expected prompt service, either because he thought market prices at the time were especially favorable, or because weather or other conditions made it desirable that the animals be moved promptly. The independent trucker has responded rather promptly to the call of the individual farmer even though such trips often involved considerable mileage to pick up one or a few animals. The trucker feared that if he did not render prompt service, the business would go to a competitor now or in the future. He felt obliged to make many local trips on which receipts did not cover operating expense in order to create and maintain good will among the farmers. Thus, over a period of years, farmers and truckers have adopted some practices which obviously are not efficient and which add to the cost of marketing the nation's livestock.

1. *Advance listing of livestock*

One possible method of bringing about greater efficiency in the use of livestock trucks would be for farmers to agree to notify the trucker of their choice well in advance of the time the animals are to be moved—anywhere from 48 hours to a full week. The longer the period the greater the opportunity for the truckers to arrange for capacity loads. This plan would interfere very little with existing arrangements and existing agencies. Each farmer would retain the right to select the trucker and the market, but forego the privilege of selecting the exact day on which his livestock was to be sold. The trucker would retain the right to serve anyone in the community and to transport the livestock to the market preferred by him or his customers.

The chief advantage, of course, would be that this plan should result in a higher proportion of the local pickup loads being loaded at or near capacity. The chief disadvantage, in addition to depriving the farmer of the right to select the time of sale, is that, at best, it would eliminate only a part, and probably a small part, of the inefficiencies that have been mentioned. Overlapping truck routes between competing truckers would not be elim-

inated, ample advance notice might not insure capacity pickup loads at all times, and the individual trucker with limited equipment might be unable to adjust the size of truck to the number of animals to be picked up. Furthermore, while a voluntary plan of this sort might appeal to farmers during emergency situations, it is questionable whether it would command their full support in normal times.

2. *Graduated local trucking rates*

Another possible method of effecting greater efficiency in the use of livestock trucks would be for the truckers in a given area to adopt uniform rates for local hauling that would tend to discourage special trips to pick up or deliver one or a few animals. The area might include the greater part or all of a county or parts of adjoining counties. By adopting a uniform schedule of minimum charges which would vary with distance regardless of the number or weight of animals to be picked up at a single stop, farmers would be discouraged from calling for individual trip service unless they had capacity or near-capacity loads. The greater the distance, the greater would be the incentive for farmers with one or a few animals to spread the charges over other animals in the community. This incentive would be sufficient in many cases to make farmers quite willing to list their livestock with the local truckers well in advance. If the rate to distant markets was the same per hundredweight whether the animals were loaded at a local assembly point or local market, or whether they were picked up at the farm or farms en route to market, the tendency would be to eliminate all unnecessary local assembly trips.

Like the preceding plan, this plan would interfere but little with existing arrangements or existing agencies. It should be somewhat more effective in reducing local truck mileage because of the financial inducement for farmers to avoid separate trips for small pickups or deliveries. It would not eliminate all overlapping trips by truckers in a given community or all crosshauling between truckers in adjacent communities, although it probably would tend to reduce both. It would have little effect on the over-the-road movement to distant markets except to encourage loading at the farm or farms en route to the market place, instead of assembling the animals locally, provided no extra charge or only a relatively slight one was made for this service. The simplicity of the plan, together with its advantages to truckers, is apparent. Its principal weakness is that it would only partially solve the problem. Furthermore, unless the savings were passed on to farmers in lower truck charges, it would make little appeal to them except in emergency situations. Then, too, it is not clear that the cooperation of all truckers, including local livestock dealers who haul for themselves or for hire or both, would be forthcoming at all times.

3. *Private trucking associations*

A third possible method would be for the livestock truckers in a given area to organize a trucking association and employ a manager who would receive listings from farmers and distribute the business among the various truckers on some acceptable basis.[12] The activities of the association might be limited largely to local hauling, or they might include both local and long-distance hauling. In either case,

[12] Before adoption, any such plan should be submitted to the Office of Defense Transportation for consideration as to its legality.

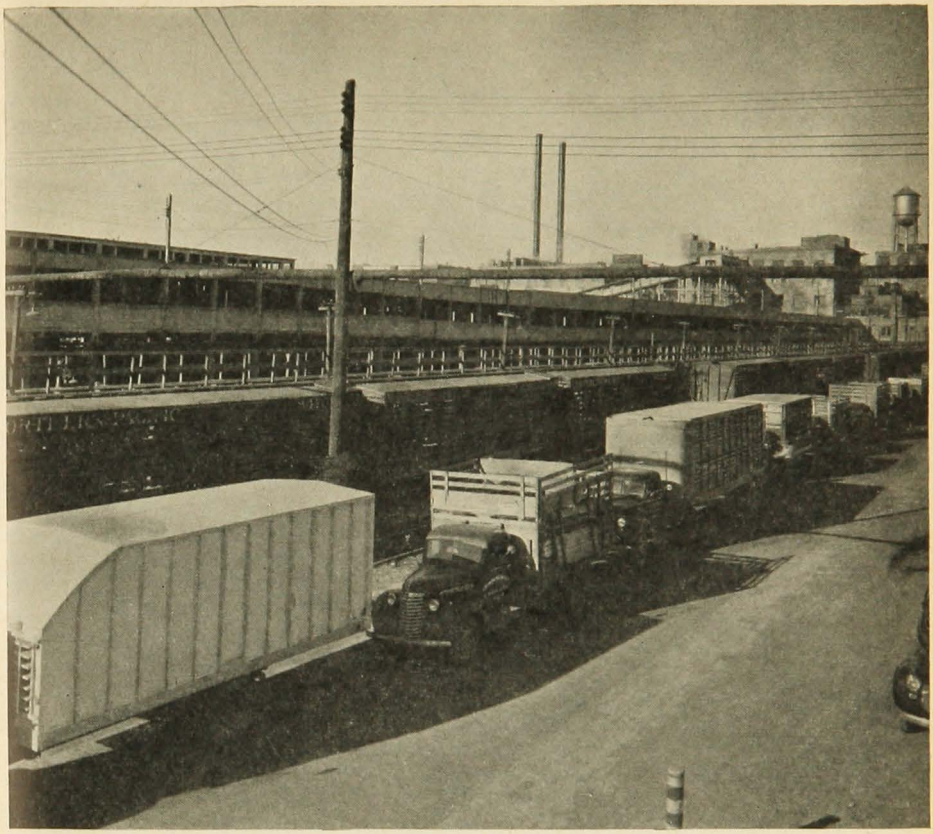

FIG. 9. Various types of trucks used for livestock hauling.

farmers would be required to list their animals with the association manager instead of with individual truckers. Listings might be required two or more days in advance so that a more efficient local pickup and delivery service could be arranged. Probably farmers would reserve the right to choose market outlets, and they might also reserve the right to designate the trucker to make the trip to the distant market. If so, the trucking association would limit its activities chiefly to problems involved in local hauling.

The local assembly or local hauling of livestock might be allocated in various ways. The business in a given community might be assigned to one or more truckers, depending upon the amount of livestock to be transported, and upon the number and capacity of the trucks owned by each. On the other hand, instead of assigning a given territory to a given trucker, the association manager might designate from among the truckers the ones to make the various trips. Regardless of the method employed, the animals could be transferred at certain designated points in the country, or at the local assembly point, to the trucker or truckers selected by the owners of the livestock. Under this plan, the

only limitation that would be placed upon the individual farmer's choice of market outlet, or his choice of long-distance trucker, would be the ability of the association manager to arrange for a capacity load.

In the event farmers reserved the right to designate market outlets, but relinquished the right to designate the truckers to make the long-distance trips, the manager of the trucking association would supervise both local and long distance hauling. This would make possible additional savings in truck mileage.

This more formal type of trucking association should reduce mileage considerably more than either of the plans mentioned earlier. If the plan included both local and long-distance trucking, it should eliminate overlapping truck trips, reduce the number of less-than-capacity loads in local hauling, and eliminate below-capacity market loads. Under emergency situations, the resulting savings in truck mileage may not only be desirable, they may be imperative. However, in the long run, the producers' interest in such a plan would depend largely upon its relative convenience, cost, and effectiveness as compared with the existing method or with some other type of organization. One obvious weakness from the producers' standpoint is that it would not necessarily result in the sale and delivery of each class, grade, and weight of livestock at the market offering the highest net return to producers. The strength of the appeal to truckers would depend upon such factors as possible savings, if any, over existing arrangements; the willingness of truckers, including local livestock dealers who operate trucks, both now and in the future to accept and abide by the plan; and the attitude of farmers toward such an arrangement.

4. *Local marketing associations*[13]

Another method of obtaining greater efficiency in the use of truck and other transportation facilities in marketing livestock would be for the farmers in a given community to organize a local cooperative marketing association. The primary objective of such an association would be to obtain the highest possible net return for each class, grade, and weight of livestock consigned by each individual producer. To attain this objective, it would be necessary for the association manager to secure daily price information from the available outlets, to grade the livestock so as to take advantage of the differences in prices offered, and to use local and long-distance transportation facilities as effectively as possible. In other words, this type of association would differ from the typical local cooperative livestock shipping association in that it would function as a marketing, instead of merely as a forwarding, association. To perform these services, the marketing association should have greater volume than the typical shipping association. Adequate volume would be necessary to enable the association to employ a competent manager with sufficient yard help and office force, provide yards and weighing facilities, pay for telephone and other communication charges, and yet compete successfully on costs with other livestock-handling agencies now operating in the local community.

It is not likely that efficient transportation, of and by itself, would insure the success of the association. It would contribute to this end, but it is doubtful that membership could be maintained in the long run merely by providing efficient transportation. The continuing success of the associa-

[13] For a more complete discussion of local cooperative marketing associations see Dowell, A. A., and Warrington, S. T., Livestock Shipping Associations. Minnesota Agricultural Experiment Station Bulletin 339, 1938.

tion would depend upon how successful it proved in marketing livestock.

Transportation facilities and rates, and the density of the livestock population, differ greatly in different areas and in different communities. Consequently, no one arrangement would be satisfactory under all conditions. In some communities it might be desirable for the cooperative to own and operate its own trucks. In others, it might be more practicable to hire private trucks. Areas near market outlets would be likely to depend largely upon trucks for both local and market hauling, while more distant areas might assemble by truck, and ship part or all of the livestock to market by rail.

By requiring members to list their animals several days in advance of marketing, it would be possible to reduce greatly the number of less-than-capacity local pickup trips. Overlapping truck routes and crosshauling would be largely eliminated, the size of trucks would be adapted to the size of the load to be picked up, and each class, grade, and weight of livestock would be transported over the most direct route to the market offering the highest net return. In other words, the association would strive to provide efficient and effective transportation service at the lowest possible cost to its members. This type of organization would have the merit of being organized and operated by and for farmers. It would have many advantages over any of the other plans mentioned, and few of the disadvantages.